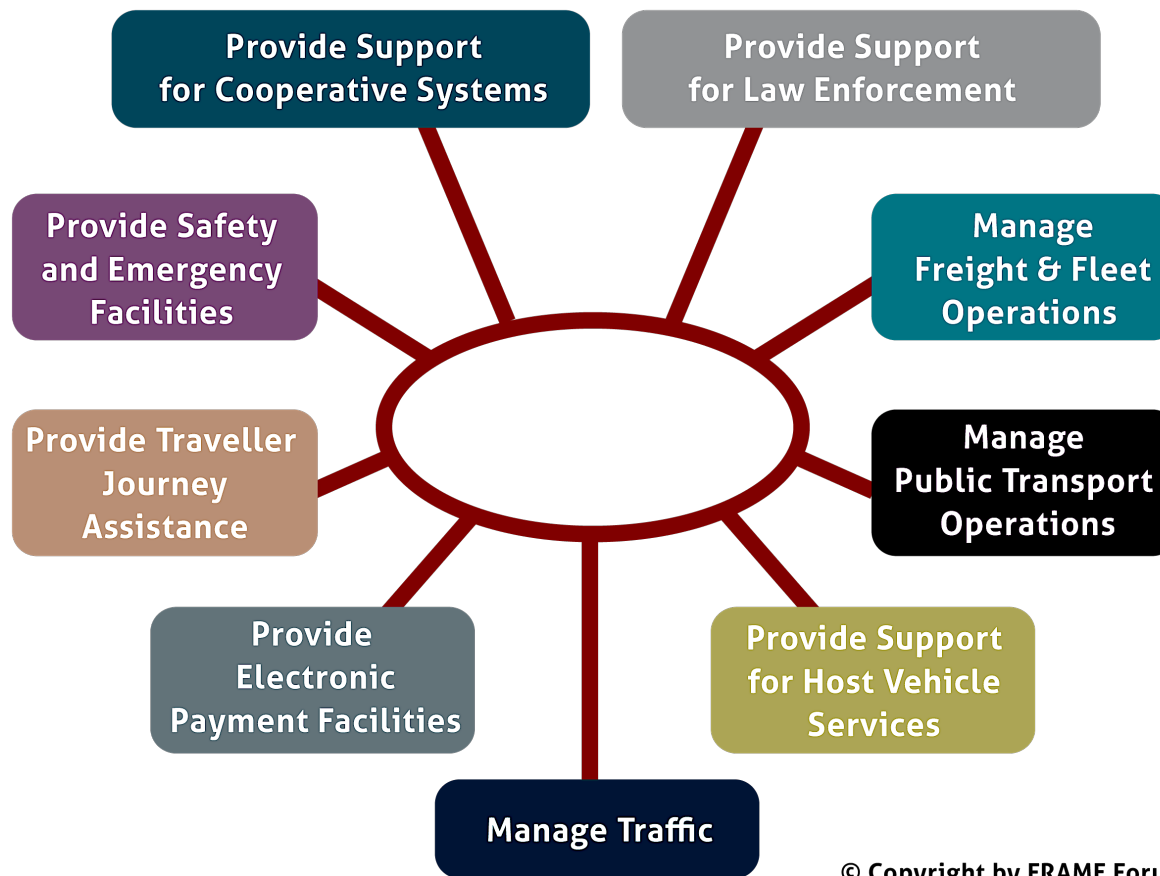# Topic 3. ITS and C-ITS applications and user services

Igor Kabashkin

Professor, Dr.hab.sc.ing.

Transport and Telecommunication Institute (Riga, Latvia)

ITS Functional Areas

Provide Support for Cooperative Systems

Provide Support for Law Enforcement

Provide Safety and Emergency Facilities

Manage Freight & Fleet Operations

Provide Traveller Journey Assistance

Manage Public Transport Operations

Provide Electronic Payment Facilities

Provide Support for Host Vehicle Services

Manage Traffic

© Copyright by FRAME Forum

ITS Services

In accordance of international standard ISO/TR 14813-2 there are 32 ITS services in 8 category.

TECHNICAL REPORT   ISO/TR 14813-2

First edition
2000-12-15

Transport information and control systems — Reference model architecture(s) for the TICS sector —

Part 2:
Core TICS reference architecture

| Service Category	Service Number	Service Name
Traveller Information	1	Pre-trip Information
	2	On-trip Driver Information
	3	On-trip Public Transport Information
	4	Personal Information Services
	5	Route Guidance and Navigation
Traffic Management	6	Transportation Planning Support
	7	Traffic Control
	8	Incident Management
	9	Demand Management
	10	Policing/Enforcing Traffic Regulations
	11	Infrastructure Maintenance Management
Vehicle	12	Vision Enhancement
	13	Automated Vehicle Operation
	14	Longitudinal Collision Avoidance
	15	Lateral Collision Avoidance
	16	Safety Readiness
	17	Pre-crash Restraint Deployment
Commercial Vehicle	18	Commercial Vehicle Pre-clearance
	19	Commercial Vehicle Administrative Processes
	20	Automated Roadside Safety Inspection
	21	Commercial Vehicle On-board Safety Monitoring
	22	Commercial Vehicle Fleet Management
Public Transport	23	Public Transport Management
	24	Demand Responsive Transport Management
	25	Shared Transport Management
Emergency	26	Emergency Notification and Personal Security
	27	Emergency Vehicle Management
	28	Hazardous Materials and Incident Notification
Electronic Payment	29	Electronic Financial Transactions
Safety	30	Public Travel Security
	31	Safety Enhancement for Vulnerable Road Users
	32	Intelligent Junctions and Links
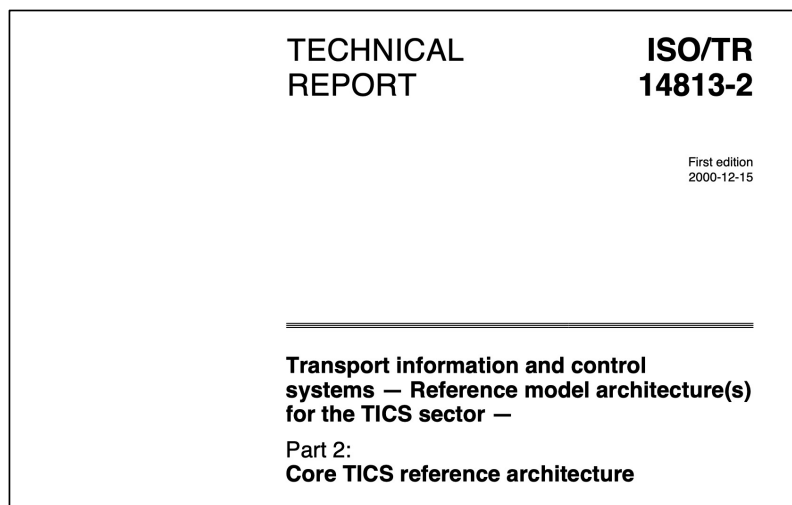
In accordance of international standard ISO/TR 14813-2 there are 32 ITS services in 8 category (see section 3 of the course). But national ITS architectures can include additional services and functions which are not listed in ISO taxonomy of services. Each functional area consists of interrelated services.

For example, the US national architecture has 33 user services in eight User Service Bundles. There is a strong emphasis on the activities of public agencies and the operation of the infrastructure. One user service bundle relates to vehicle oriented services. There is a commercial vehicle bundle, but it is focused on the interaction of commercial vehicles with public authorities, rather than such activities as fleet management.

User service bundle	User service
Traveller information Services	■ Pre-trip Information ■ On-trip Information ■ Travel Services Information ■ Route Guidance and Navigation – Pre-trip ■ Route Guidance and Navigation – On-trip ■ Trip Planning Support
Traffic Management and Operations Services	■ Traffic Management and Control ■ Transport Related Incident Management ■ Demand Management ■ Transport Infrastructure Maintenance Management ■ Policing/Enforcement
Vehicle Services	■ Vision Enhancement ■ Automated Vehicle Operation ■ Collision Avoidance ■ Safety Readiness ■ Pre-crash Restraint
Freight Transport Services	■ Commercial Vehicle Pre-clearance ■ Commercial Vehicle Administrative Processes ■ Automated Roadside Safety Inspection ■ Commercial Vehicle On-board Safety Monitoring ■ Freight Transport Fleet Management ■ Intermodal Information Management ■ Management and Control of Intermodal Centres ■ Management of Dangerous Freight
Public Transport Services	■ Public Transport Management ■ Demand Responsive and Shared Transport
Emergency Services	■ Transport Related Emergency Notification and Personal Security ■ After Theft Vehicle Recovery ■ Emergency Vehicle Management ■ Hazardous Materials and Incident Notification
Transport-related Electronic Payment Services	■ Transport-related Electronic Financial Transactions ■ Integration of Transport Related Electronic Payment Services
Road Transport Related Personal Safety	■ Public Travel Security ■ Safety Enhancements for Vulnerable Road Users ■ Safety Enhancements for Disabled Road Users ■ Safety Provisions for Pedestrians Using Intelligent Junctions and Links
Weather and Environmental Conditions Monitoring Services	■ Weather Monitoring ■ Environmental Conditions Monitoring
Disaster Response Management and Coordination Services	■ Disaster Data Management ■ Disaster Response Management ■ Coordination With Emergency Agencies
National Security Services	■ National Security Services ■ Monitoring and Control of Suspicious Vehicles ■ Utility, Structures and Pipeline Monitoring

ITS Functions (applictions)
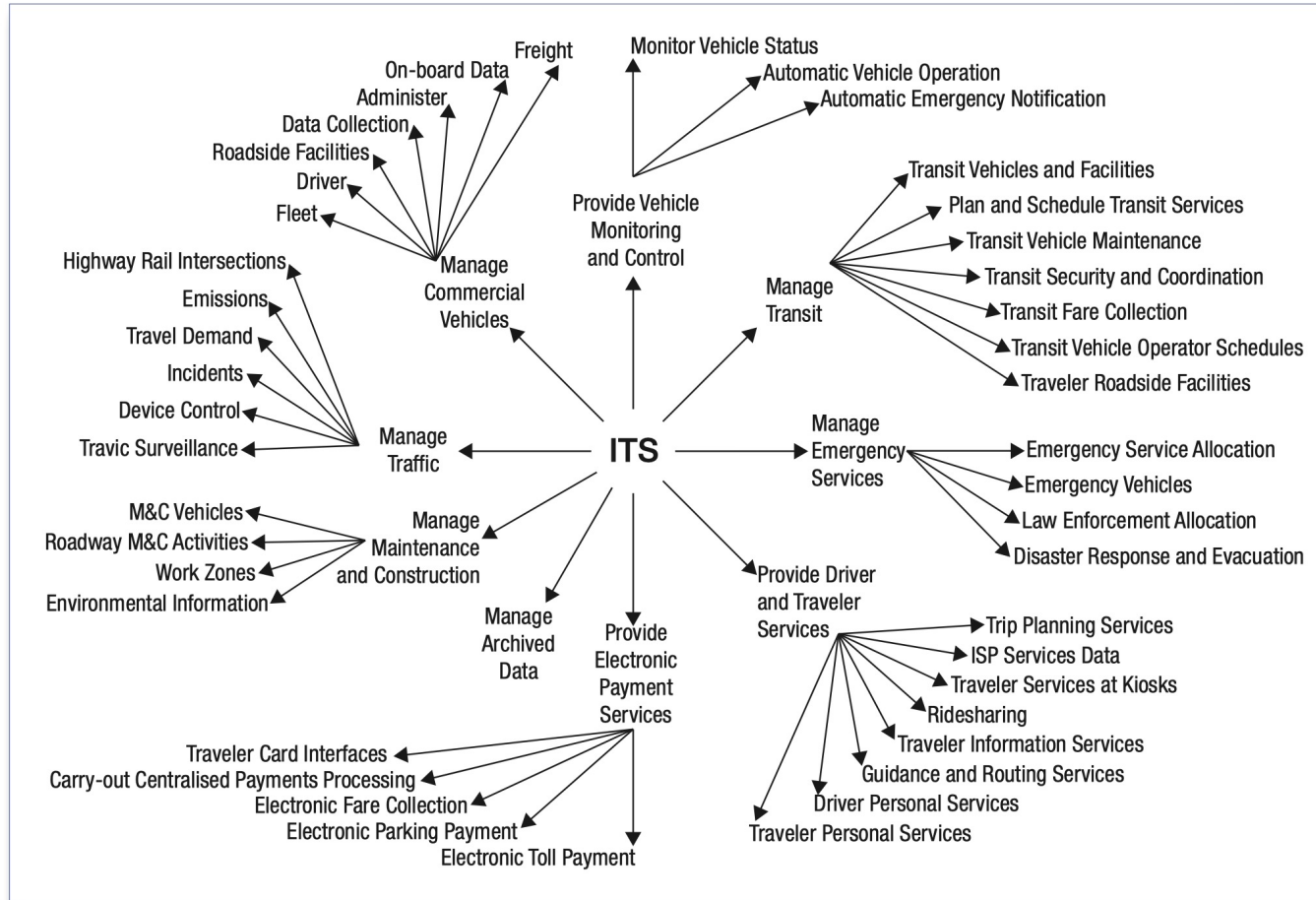
INTERNATIONAL STANDARD

ISO 14813-1

**Intelligent transport systems —
Reference model architecture(s) for the
ITS sector —**

**Part 1:
ITS service domains, service groups and
services**

Service domain	Service group	Example services
1. Traveller information	1.1 Pre-trip information	Pre-trip information – Traffic and roadway
		Pre-trip information – Public transport (bus and rail)
		Pre-trip information – Commercial vehicle
		Pre-trip information – Personal interactive
		Pre-trip information – Modal changes and multi-modal information
	1.2 On-trip information	On-trip information – Roadside
		On-trip information – In-vehicle signing
		On-trip information – Public transport vehicle
		On-trip Information – Parking information
		On-trip information – Mobile devices
	1.3 Route guidance and navigation – Pre-trip	Dynamic in-vehicle route guidance and navigation programming/setup
		Integrated multi-modal trip guidance
		Pedestrian and bicycle route guidance
	1.4 Route guidance and navigation – On-trip	Autonomous in-vehicle navigation
		Dynamic in-vehicle route guidance and navigation (based on real-time network information)
		Integrated multi-modal trip guidance
		Pedestrian and bicycle route guidance
	1.5 Trip planning support	Individual trip planning
		Centralized trip planning
		Data archiving
		Data warehouse
	1.6 Travel services information	Travel services information – In-vehicle
		Travel services information – Personal interactive
		Travel services information – Dedicated location

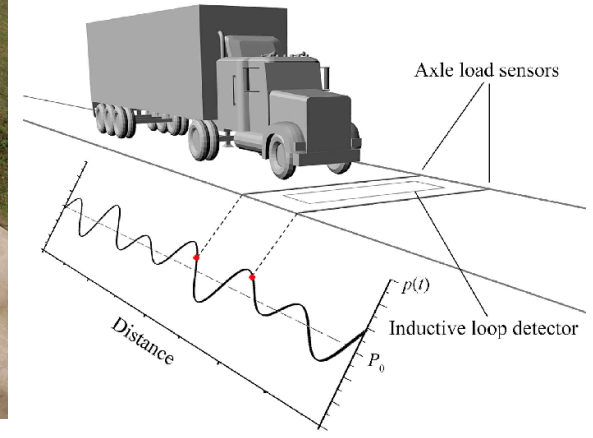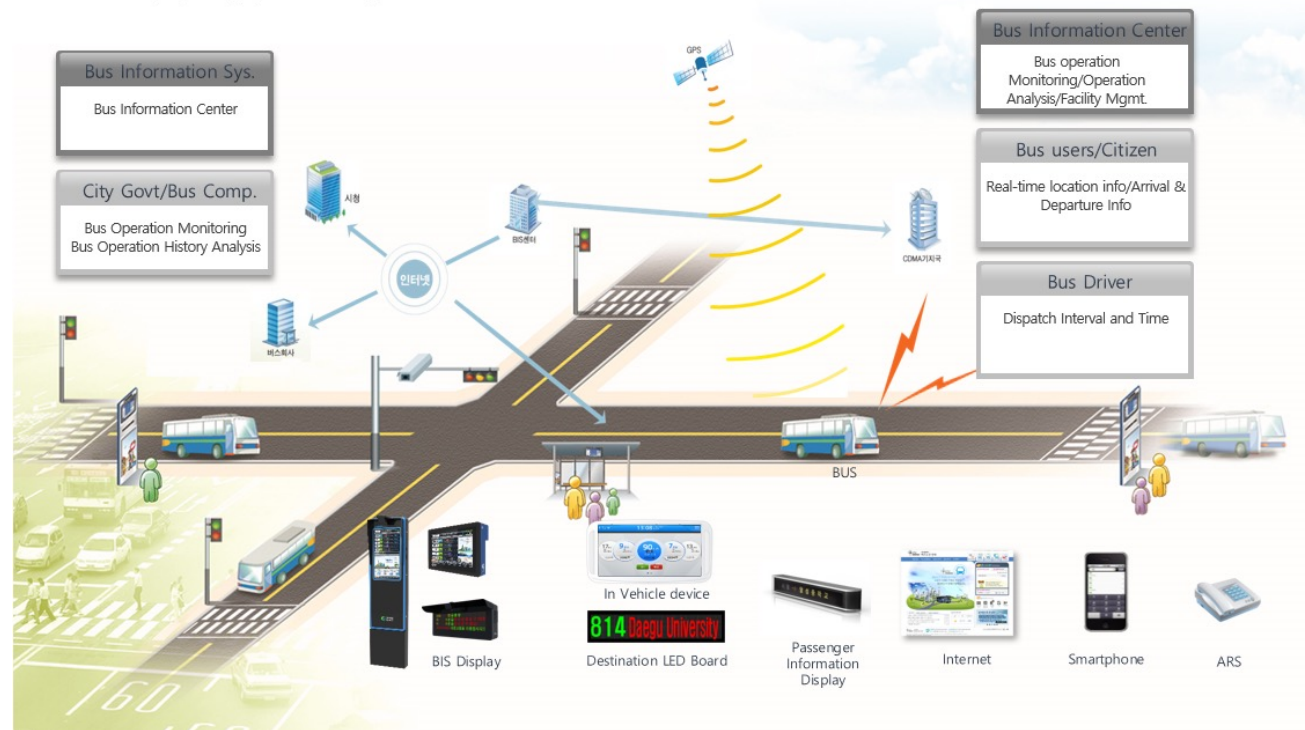| Service domain	Service group	Example services
2. Traffic management and operations	2.1 Traffic management and control	Traffic monitoring
		Surface street control
		Freeway traffic control
		Preferential treatment for specific vehicle types (signal priority and pre-emption)
		Reversible lane management
		Coordination of surface street and freeway control
		Intermodal highway junction management
		Parking management
		Work zone traffic management
		Traffic information dissemination
	2.2 Transport-related incident management	Incident monitoring and confirmation
		Incident on-site motorist assistance
		Incident on-site traveller assistance
		Incident coordination and clearance
		Hazardous materials monitoring and management
	2.3 Demand management	Variable road pricing
		Access management
		High-occupancy lane management
		Air quality-based transport management
	2.4 Transport infrastructure maintenance management	Roadway construction and maintenance management
		Winter maintenance
		Pavement management
		Automated road management
		Work zone safety management
	2.5 Policing/ enforcing traffic regulations	Access control
		High-occupancy vehicle facility usage
		Parking regulation enforcement
		Speed limit enforcement
		Signal enforcement (e.g. red light violation)
		Emissions monitoring

Traffic Management Centres
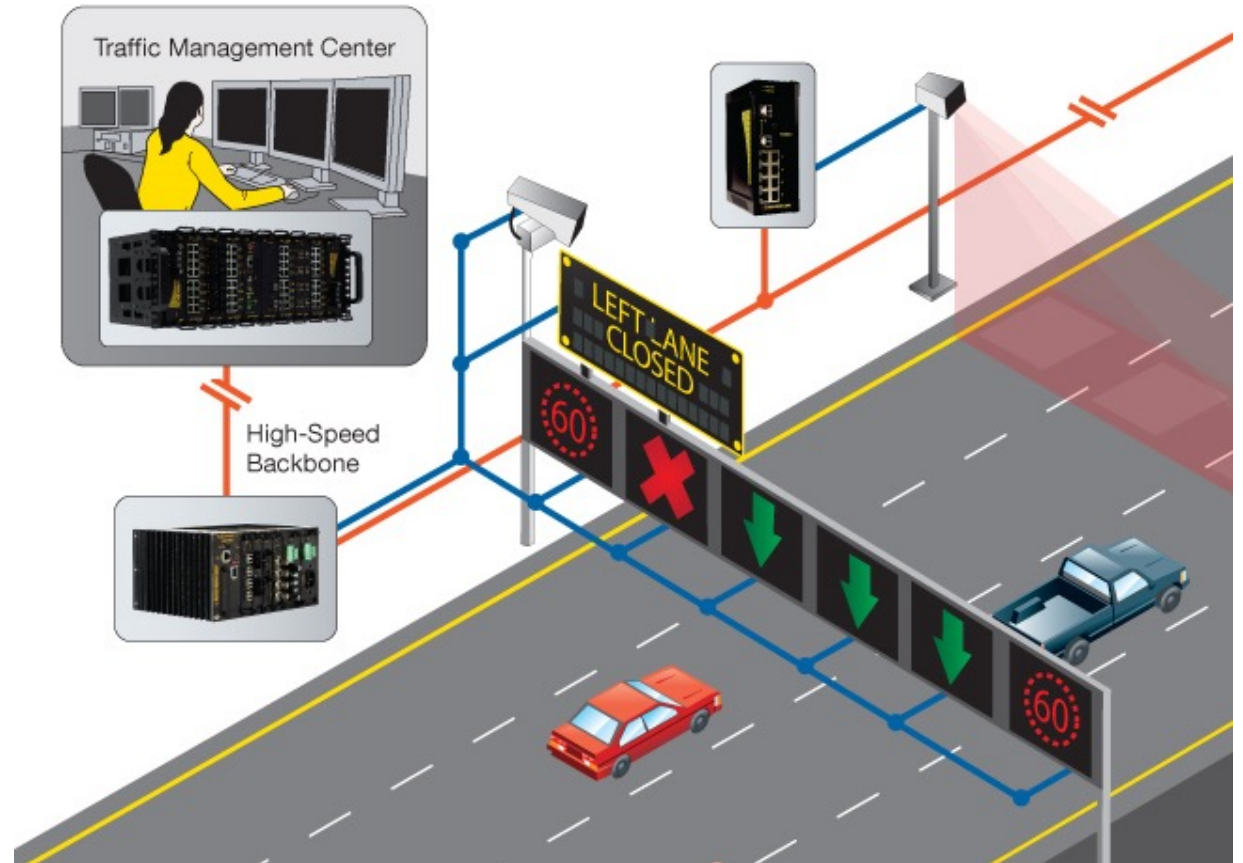
Traffic Management Centres

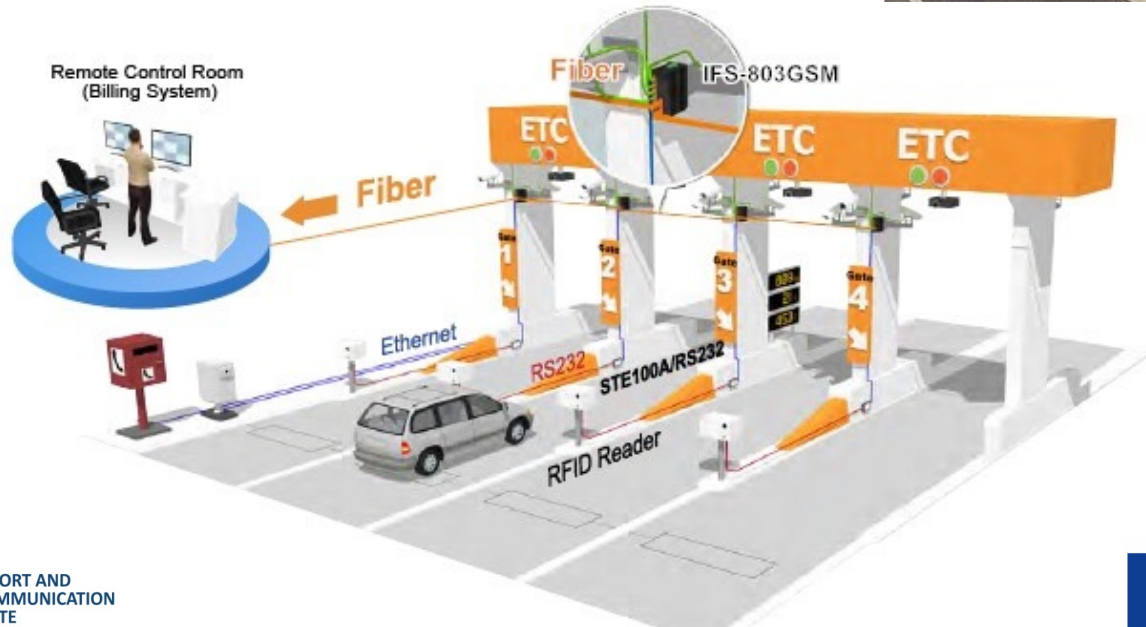| Service domain	Service group	Example services
3. Vehicle	3.1 Transport-related vision enhancement	In-vehicle driver vision management
	3.2 Automated vehicle operation	Automated highway operation
		Automated low-speed manoeuvring
		Precision docking for public transport vehicles
		Automated cruise control
	3.3 Collision avoidance	Longitudinal collision avoidance
		Lateral collision avoidance
		Intersection collision avoidance
	3.4 Safety readiness	Vehicle internal systems monitoring
		Vehicle external conditions monitoring
	3.5 Pre-crash restraint deployment	Pre-crash restraint deployment
4. Freight transport	4.1 Commercial vehicle pre-clearance	Weigh-in-motion
		Non-stop pre-clearance
		Vehicle safety records monitoring
	4.2 Commercial vehicle administrative processes	Automated credential filing
		Automated commercial vehicle administration
		Automated border crossings
	4.3 Automated roadside safety inspection	Remote access to commercial vehicle safety data
	4.4 Commercial vehicle onboard safety monitoring	Commercial vehicle internal systems monitoring
		Commercial vehicle driver alertness monitoring
	4.5 Freight transport fleet management	Commercial vehicle fleet tracking
		Commercial vehicle fleet dispatching
		Freight container tracking
	4.6 Intermodal information management	Vehicle and container arrival information exchange
		Customer freight information access

Service domain	Service group	Example services
	4.7 Management and control of intermodal centres	Intermodal centre facility management
		Intermodal vehicle and container control
	4.8 Management of dangerous freight	Dangerous goods movement data sharing
		Dangerous goods movement data registry
		Dangerous goods movement fleet coordination
		Dangerous goods movement police/safety coordination
5. Public transport	5.1 Public transport management	Public transport vehicle internal systems monitoring
		Public transport vehicle fleet tracking
		Public transport scheduling services
		Public transport service dispatch
		Public transport service planning
	5.2 Demand responsive and shared transport	Paratransit fleet dispatch
		Dynamic ridesharing
6. Emergency	6.1 Transport-related emergency notification and personal security	Automated emergency call and mayday dispatch
		Automated vehicle intrusion and stolen vehicle monitoring
	6.2 After-theft vehicle recovery	User-initiated distress calls
		Automated theft warning
		Automated vehicle intrusion and stolen vehicle monitoring
		Stolen vehicle tracking
		Remote vehicle immobilization
	6.3 Emergency vehicle management	Emergency vehicle fleet tracking
		Emergency vehicle traffic management coordination
	6.4 Hazardous materials and incident notification	HAZMAT vehicle tracking
		Automated HAZMAT emergency call/mayday notification
		HAZMAT pre-clearance services

Emotion's a state-of-the-art public transportation system enabled government, bus operator and public to maximizes the convenience of bus use by improving operation management such as bus intervals and timeliness.
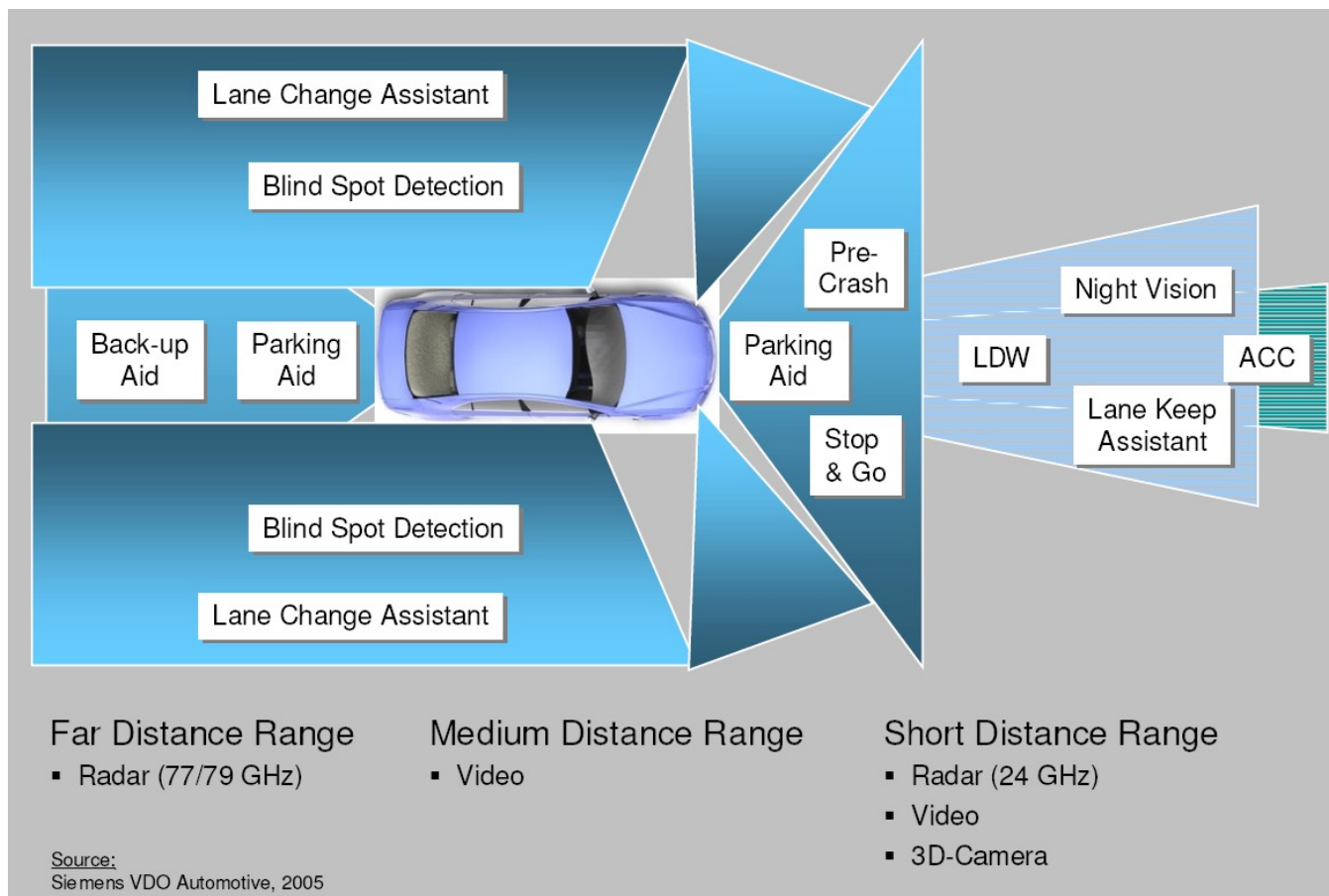
Service domain	Service group	Example services
7. Transport-related electronic payment	7.1 Transport-related electronic financial transactions	
		Electronic transit fare payment
		Electronic toll collection
		Electronic parking payment
		Electronic services payment (e.g. traveller information, reservations)
		Electronic distance-based road user fee payment services
	7.2 Integration of transport-related electronic payment services	
		Integration of multi-jurisdictional electronic payment systems
		Integration of regional multi-modal payment systems
8. Road transport-related personal safety	8.1 Public travel security	
		Silent alarm
		Emergency call/mayday alert for public transport
		Intrusion detection
		Public transport surveillance
	8.2 Safety enhancements for vulnerable road users	
		Non-motorized vehicle and pedestrian monitoring systems
		Systems to monitor specialized vehicles
	8.3 Safety enhancements for disabled road users	Intersection monitoring of specialized conveyances (e.g. wheelchairs, carts)
		Driver warnings for specialized conveyances
	8.4 Safety provisions for pedestrians using intelligent junctions and links	
		Signal display advance warning
		Oncoming vehicle advance warning (for non-signalized junction)
		In-vehicle signage and warning systems
9. Weather and environmental conditions monitoring	9.1 Weather monitoring	
		Road weather information monitoring
		Road weather prediction
	9.2 Environmental conditions monitoring	
		Water level/tidal monitoring and prediction
		Seismic monitoring
		Pollution monitoring
		Avalanche, mud slide and fallen rock monitoring

| Service domain	Service group	Example services
10. Disaster response management and coordination	10.1 Disaster data management	
		Disaster and emergency data collection
		Disaster and emergency data sharing
	10.2 Disaster response management	*Disaster response planning for the transport network*
		Disaster response implementation
	10.3 Coordination with emergency agencies	*Disaster response coordination*
11. National security	11.1 Monitoring and control of suspicious vehicles	*Vehicle HAZMAT and explosives monitoring*
		Vehicle disablement
		Road traffic management
		Identification of suspicious vehicles
	11.2 Utility or pipeline monitoring	*Pipeline and utility HAZMAT/explosives monitoring*
		Emergency notification to key agencies
12. ITS Data Management	12.1 Data registries	*Registration of ITS data concepts and subroutines for re-use and interoperability*
	12.2 Data dictionaries	*Local registration of ITS data concepts and subroutines for re-use and interoperability*
	12.3 Emergency messages	*Registration of emergency related messages, both originated from vehicles and from transport system users via portable or other devices, to provide interpretable data to assistance providers that is relevant to the emergency*
	12.4 Control centre data	*Registration of data concepts that may be exchanged between control centres*
	12.5 Enforcement	*Data storage and exchange for law enforcement*
	12.6 Traffic management data	*Data storage and exchange for use within and between traffic management centres, road operators, government agencies, law enforcement and emergency services*

Advanced Driver Assistance System

Lane Change Assistant

Blind Spot Detection

Back-up Aid

Parking Aid

Pre-Crash

Parking Aid

Stop & Go

Night Vision

LDW

Lane Keep Assistant

ACC

Blind Spot Detection

Lane Change Assistant

Far Distance Range
- Radar (77/79 GHz)

Medium Distance Range
- Video

Short Distance Range
- Radar (24 GHz)
- Video
- 3D-Camera

Source:
Siemens VDO Automotive, 2005

Examples of driver assistance systems

Longitudinal control

City Break Assist
Front Assist

Lateral control
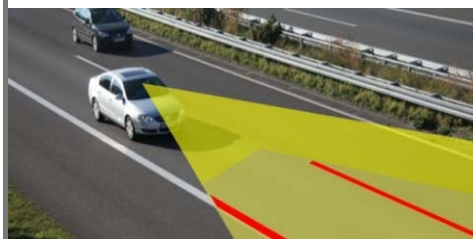
Side Assist
Lane Assist

Park assist systems

Park Assist

Light

Light Assist

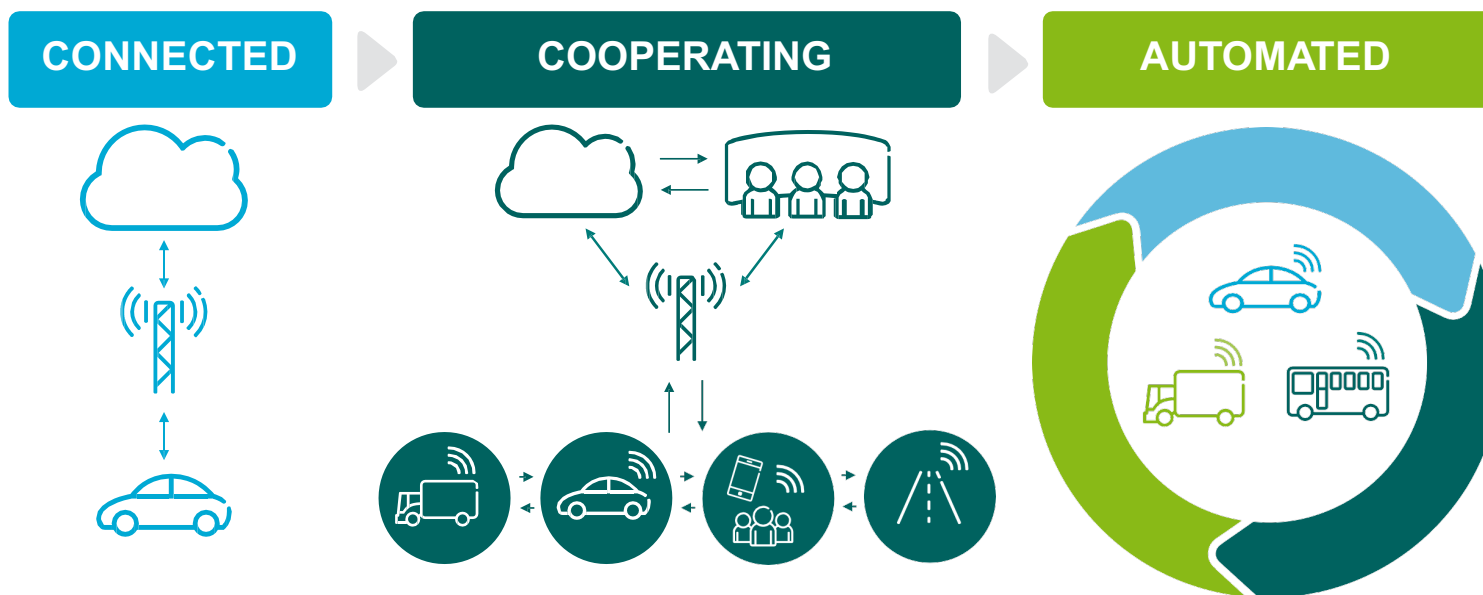## Recommendation

Pause
Recommendation

Driver information

Sign Assist

Future trends of ITS

TOMORROW STARTS NOW

Source: Ericsson, 2014

Cooperative Intelligent Transport Systems and Services C-ITS

Cooperative Intelligent Transport Systems and Services (C-ITS) refers to transport systems, where the cooperation between two or more ITS sub-systems (personal, vehicle, roadside and central) enables and provides an ITS service that offers better quality and an enhanced service level, compared to the same ITS service provided by only one of the ITS sub-systems.

According to the C-ITS Deployment Platform having been organised by the European Commission, cooperative Intelligent Transport Systems (C-ITS) shall use mature ad-hoc short-range (like ETSI ITS G5) and complementing wide-area communication technologies (like 3G, 4G, future 5G) that allow road vehicles to communicate with other vehicles, traffic signals, roadside infrastructure and other road users.

The cooperative **V2X** systems are also known as vehicle-to-vehicle communications (**V2V**), vehicle-to-infrastructure communications (**V2I**) or vehicle-to-person (**V2P**) communications. In summary, the wireless data exchange between the different actors and ITS stations and related functions are named cooperative V2X communication. It supports a number of information, warning and assistance services which will be gradually deployed in coordinated innovation phases during the oncoming years.
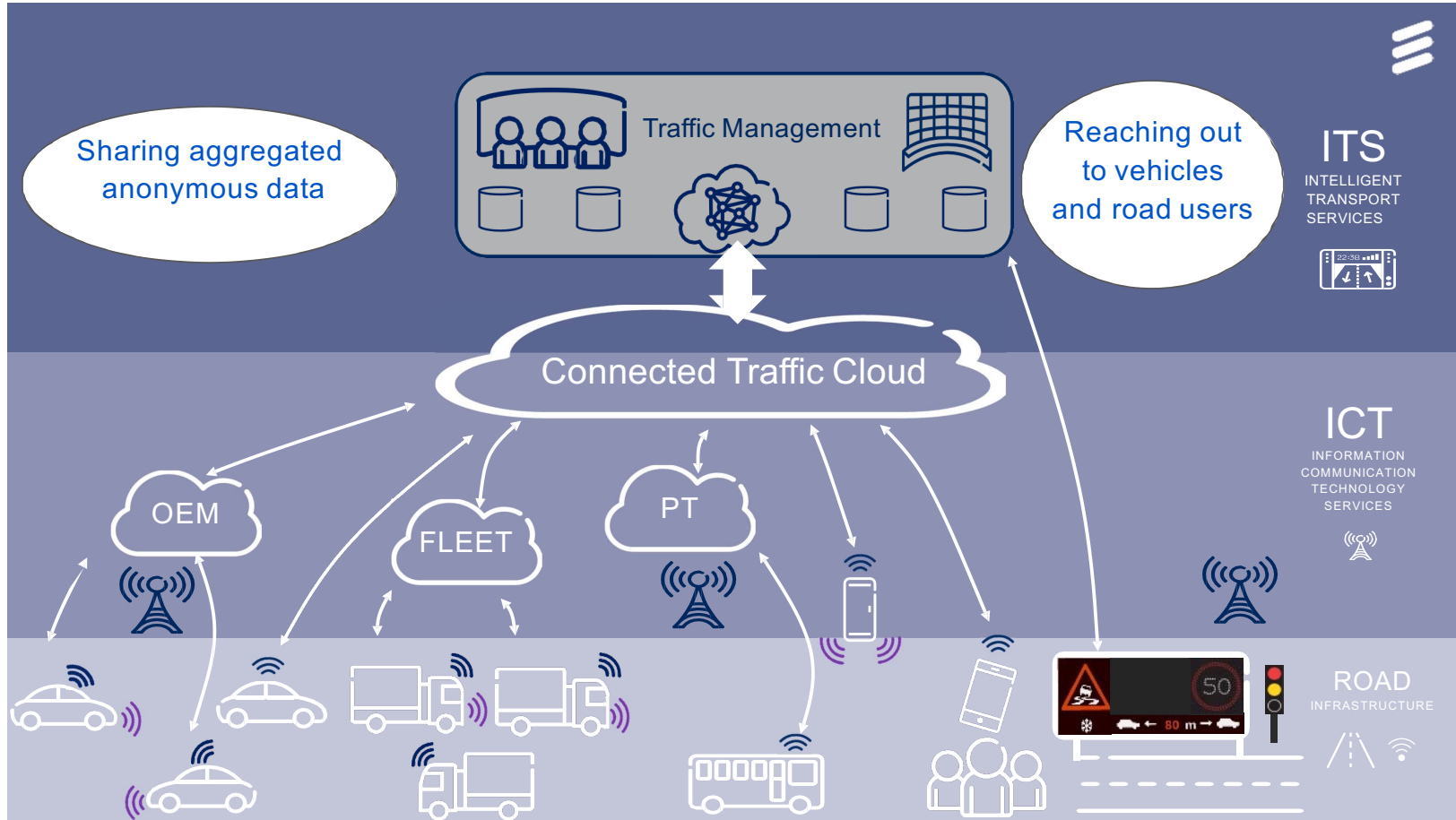
Cooperation and Communication

V2V — Vehicle-to-vehicle

V2I — Vehicle-to-infrastructure

I2V — Infrastructure-to-vehicle

V2X — Vehicle-to-anything
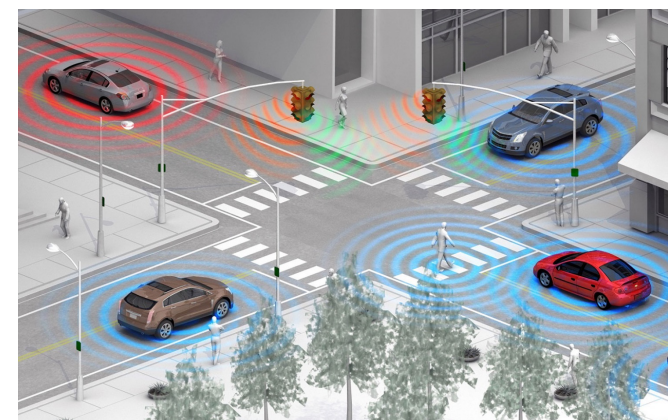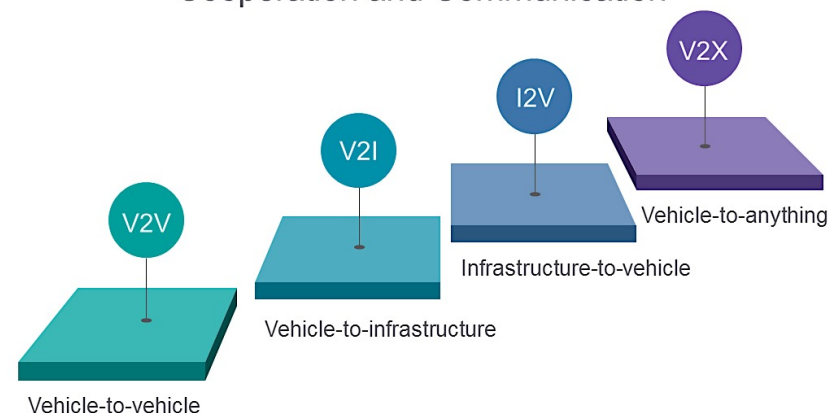
V2X = V2V + V2I + V2P
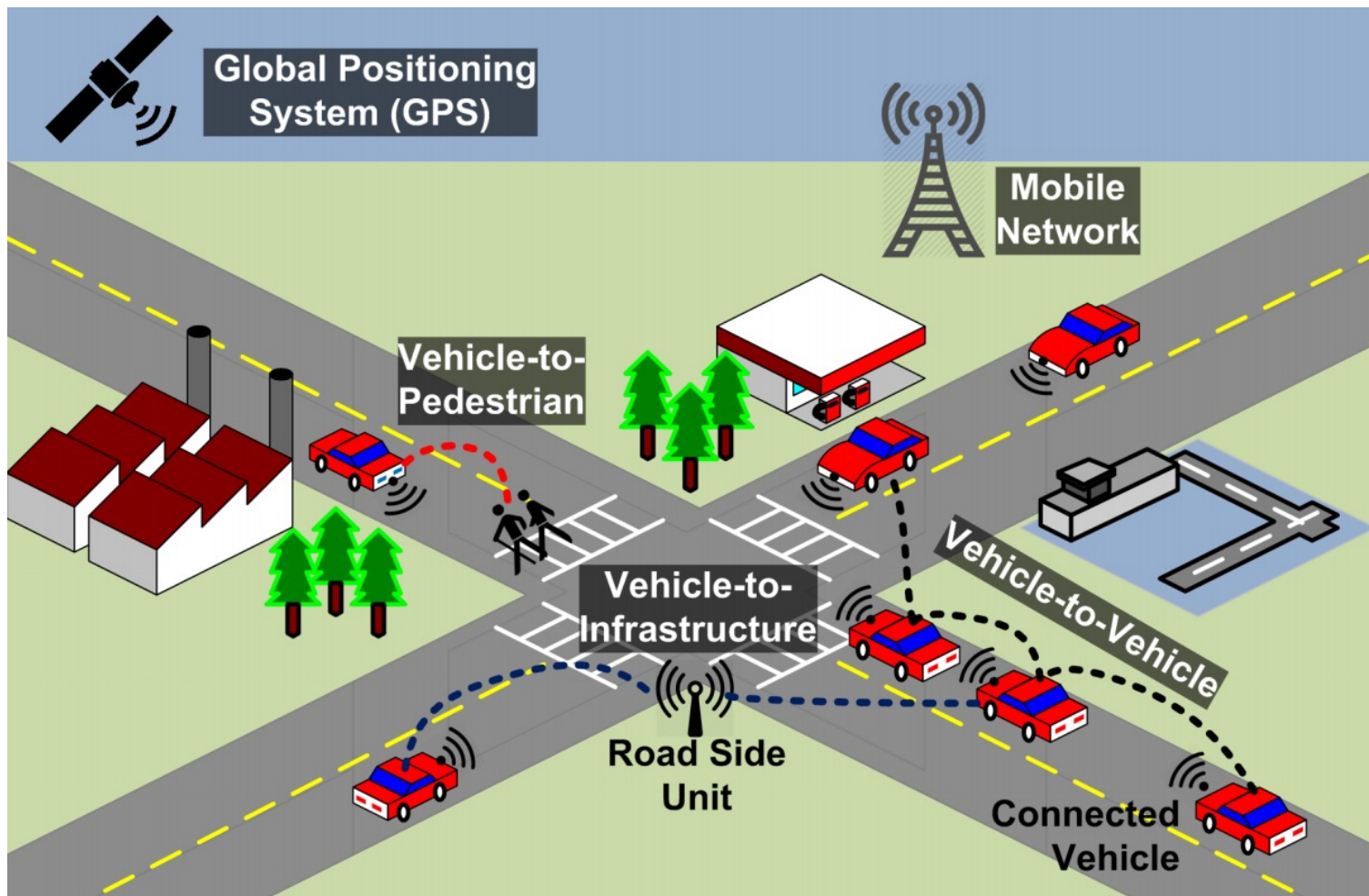
ITS enabled by Mobile Broadband and cloud

Topic 3. ITS and C-ITS applications and user services

Intelligent Transportation Systems

Igor Kabashkin (kiv@tsi.lv)

Professor, Dr.hab.sc.ing.

Transport and Telecommunication Institute (Riga, Latvia)